



TFT LCD Tentative Specification

MODEL NO.: V460H1 - L09

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CONTENTS -

REVISION HISTORY	3
1. GENERAL DESCRIPTION	4
1.1 OVERVIEW	
1.2 FEATURES	
1.3 APPLICATION	
1.4 GENERAL SPECIFICATIONS	
1.5 MECHANICAL SPECIFICATIONS	
2. ABSOLUTE MAXIMUM RATINGS	5
2.1 ABSOLUTE RATINGS OF ENVIRONMENT	
2.2 ELECTRICAL ABSOLUTE RATINGS	
2.2.1 TFT LCD MODULE	
2.2.2 BACKLIGHT INVERTER UNIT	
3. ELECTRICAL CHARACTERISTICS	7
3.1 TFT LCD MODULE	
3.2 BACKLIGHT UNIT	
3.2.1 CCFL(Cold Cathode Fluorescent Lamp) CHARACTERISTICS	
3.2.2 INVERTER CHARACTERISTICS	
3.2.3 INVERTER INTERFACE CHARACTERISTICS	
4. BLOCK DIAGRAM	14
4.1 TFT LCD MODULE	
5. INTERFACE PIN CONNECTION	15
5.1 TFT LCD MODULE	
5.2 BACKLIGHT UNIT	
5.3 INVERTER UNIT	
5.4 BLOCK DIAGRAM OF INTERFACE	
5.5 LVDS INTERFACE	
5.6 COLOR DATA INPUT ASSIGNMENT	
6. INTERFACE TIMING	25
6.1 INPUT SIGNAL TIMING SPECIFICATIONS	
6.2 POWER ON/OFF SEQUENCE	
7. OPTICAL CHARACTERISTICS	29
7.1 TEST CONDITIONS	
7.2 OPTICAL SPECIFICATIONS	
8. DEFINITION OF LABELS	33
9. PACKAGING	35
9.1 PACKING SPECIFICATIONS	
9.2 PACKING METHOD	
10. PRECAUTIONS	38
10.1 ASSEMBLY AND HANDLING PRECAUTIONS	
10.2 SAFETY PRECAUTIONS	
10.3 SAFETY STANDARDS	
11. MECHANICAL CHARACTERISTICS	39

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Issued Date: Nov. 30, 2009

Model No.: V460H1 - L09

Tentative**REVISION HISTORY**

Version	Date	Page (New)	Section	Description
Ver 0.0 Ver 0.1	Nov. 25,'09 Nov. 30,'09	All 15	All 5.1	Tentative Specification was first issued. LVDS pin defined.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

V460H1-L09 is a 46" TFT Liquid Crystal Display module with 14-CCFL Backlight unit and 2ch-LVDS interface. This module supports 1920 x 1080 HDTV format and can display true 16.7M colors (8-bit /color).

The inverter for backlight is built-in.

1.2 FEATURES

- High brightness (450nits)
- High contrast ratio (6000:1)
- Fast response time (Gray to Gray average 6.5 ms)
- High color saturation (72% NTSC)
- Full HDTV (1920 x 1080 pixels) resolution, true HDTV format
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface
- Optimized response time for 50/60 Hz frame rate
- Ultra wide viewing angle: Super MVA technology

1.3 APPLICATION

- Standard Living Room TVs.
- Public Display Application.
- Home Theater Application.
- MFM Application.

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	1018.08(H) x 572.67(V) (46" diagonal)	mm	(1)
Bezel Opening Area	1024.4(H) x 579.2(V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920x R.G.B. x 1080	pixel	-
Pixel Pitch(Sub Pixel)	0.17675(H) x 0.53025(V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M	color	-
Display Operation Mode	Transmissive mode / Normally black	-	-
Surface Treatment	Anti-Glare coating (Haze 11%) Hardness (3H)	-	(2)

Note (1) Please refer to the attached drawings in chapter 9 for more information about the front and back outlines.

Note (2) The spec of the surface treatment is temporarily for this phase. CMO reserves the rights to change this feature.

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	-	1083	-	mm	(1), (2)
	Vertical (V)	-	627	-	mm	
	Depth (D)	-	51.2	-	mm	
Weight		-	TBD	-	g	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.



Note (2) Module Depth does not include connectors.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T _{OP}	0	50	°C	(1), (2)
Shock (Non-Operating)	S _{NOP}	X, Y axis	50	G	(3), (5)
		Z axis	35	G	(3), (5)
Vibration (Non-Operating)	V _{NOP}	-	1.0	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. ($T_a \leq 40$ °C).

(b) Wet-bulb temperature should be 39 °C Max. ($T_a > 40$ °C).

(c) No condensation.

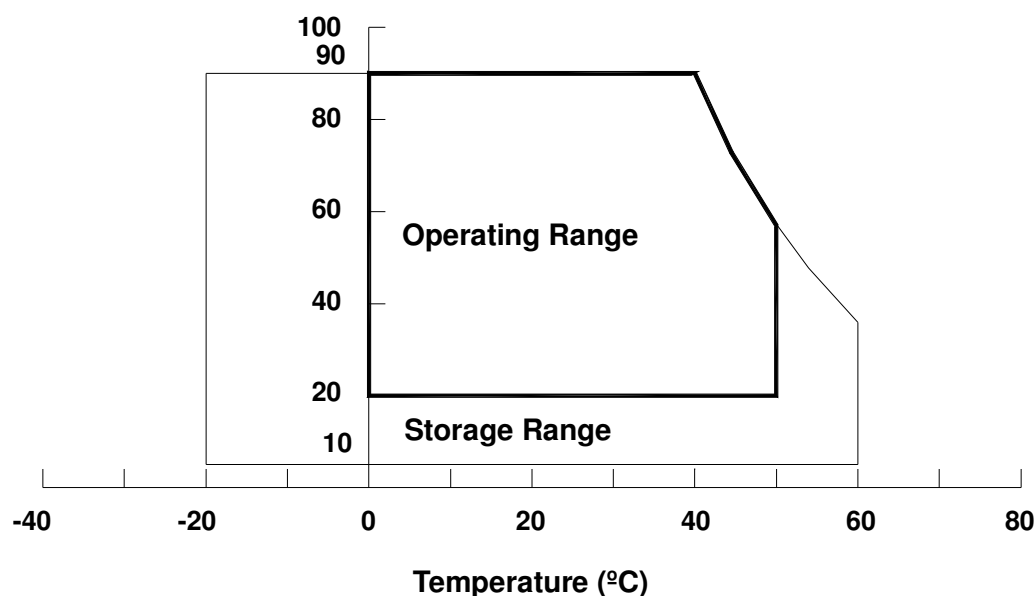
Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in your product design to prevent the surface temperature of display area from being over 65 °C. The range of operating temperature may degrade in case of improper thermal management in your product design.

Note (3) 11 ms, half sine wave, 1 time for $\pm X$, $\pm Y$, and $\pm Z$.

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture. The module would not be twisted or bent by the fixture.

Relative Humidity (%RH)



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V_{CC}	-0.3	13.5	V	(1)
Logic Input Voltage	V_{IN}	-0.3	3.6	V	

2.2.2 BACKLIGHT INVERTER UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V_W	—	3000	V_{RMS}	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

3. ELECTRICAL CHARACTERISTICS

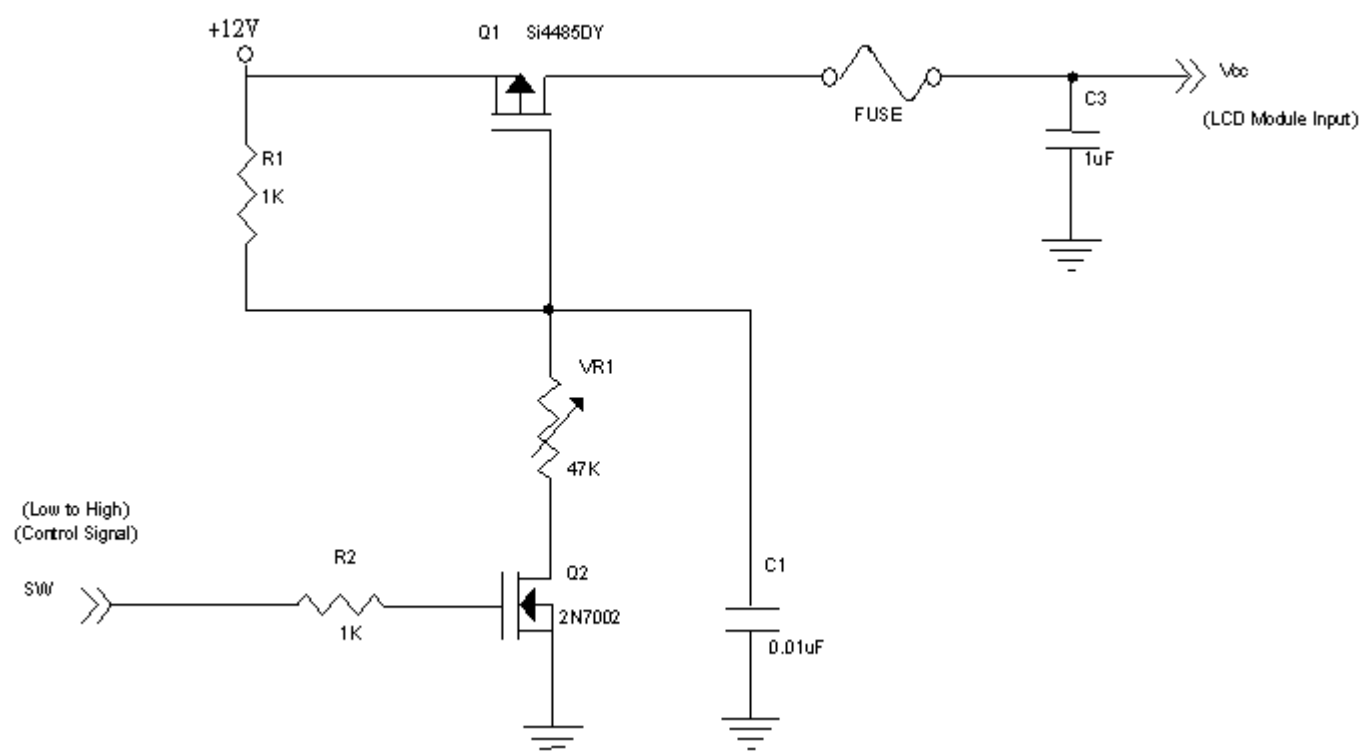
3.1 TFT LCD MODULE

(Ta = 25 ± 2 °C)

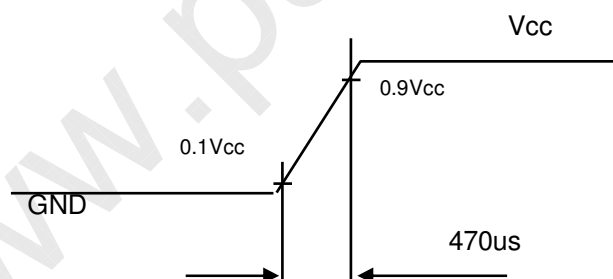
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V _{CC}	10.8	12	13.2	V	(1)
Rush Current		I _{RUSH}	—	—	1.9	A	(2)
Power Supply Current	White Pattern	I _{CC}	—	0.5	—	A	(3)
	Black Pattern		—	0.49	—	A	
	Horizontal Stripe		—	1.2	1.47	A	
LVDS Interface	Differential Input High Threshold Voltage	V _{LVTH}	+100	—	—	mV	(4)
	Differential Input Low Threshold Voltage	V _{LVTL}	—	—	-100	mV	
	Common Input Voltage	V _{CM}	1.0	1.2	1.4	V	
	Differential input voltage	V _{ID}	200	—	600	ohm	
	Terminating Resistor	R _T	-	100	-		
CMOS interface	Input High Threshold Voltage	V _{IH}	2.7	—	3.3	V	
	Input Low Threshold Voltage	V _{IL}	0	—	0.7	V	

Note (1) The module should be always operated within the above ranges.

Note (2) Measurement condition:



Vcc rising time is 470us



Note (3) The specified power supply current is under the conditions at $V_{CC} = 12V$, $T_a = 25 \pm 2^\circ C$, $f_v = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



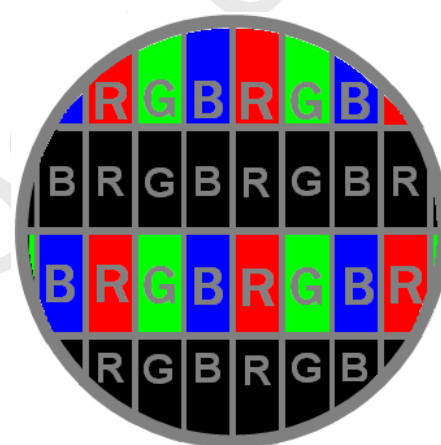
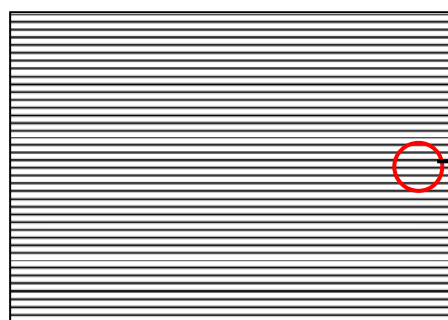
Active Area

b. Black Pattern

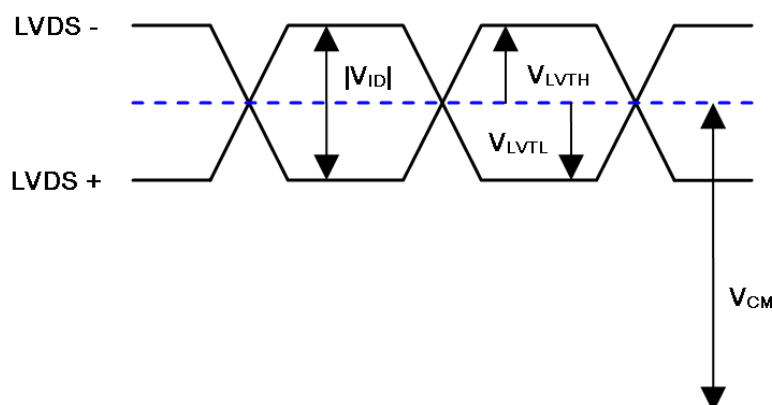


Active Area

c. Horizontal Pattern



Note (4) The LVDS input characteristics are as follows:



3.2 BACKLIGHT UNIT

3.2.1 CCFL (Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V _L	-	1100	-	V _{RMS}	-
Lamp Current	I _L	9.7	10.2	10.7	mA _{RMS}	(1)
Lamp Turn On Voltage	V _S	-	-	1820	V _{RMS}	(2), Ta = 0 °C
		-	-	1650	V _{RMS}	(2), Ta = 25 °C
Operating Frequency	F _L	30	-	80	KHz	(3)
Lamp Life Time	L _{BL}	50,000	-	-	Hrs	(4)

3.2.2 INVERTER CHARACTERISTICS (Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Total Power Consumption	P ₂₅₅	-	155	TBD	V	(6)
Power Supply Voltage	V _{BL}	22.8	24	25.2	V	
Power Supply Current	I _{BL}	-	6.46	TBD	Arms	No Dimming
Input Ripple Noise	-	-	-	912	kHz	
Oscillating Frequency	F _W	37	40	43	mA	H.V (5)
Dimming frequency	F _B	150	160	170	Hz	Dimming frequency
Minimum Duty Ratio	D _{MIN}	-	20	-	%	Minimum Duty Ratio

Note (1) Lamp current is measured by utilizing AC current probe and its value is average by measuring master and slave board.

Note (2) The lamp starting voltage V_S should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may produce interference with horizontal synchronous frequency of the display input signals, and it may result in line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) The life time of a lamp is defined as when the brightness is larger than 50% of its original value and the effective discharge length is longer than 80% of its original length (Effective discharge length is defined as an area that has equal to or more than 70% brightness compared to the brightness at the center point of lamp.) as the time in which it continues to operate under the condition at Ta = 25 ± 2°C and I_L = 9.7~ 10.7mA_{RMS}.

Note (5) The power supply capacity should be higher than the total inverter power consumption P_{BL}. Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when inverter dimming.

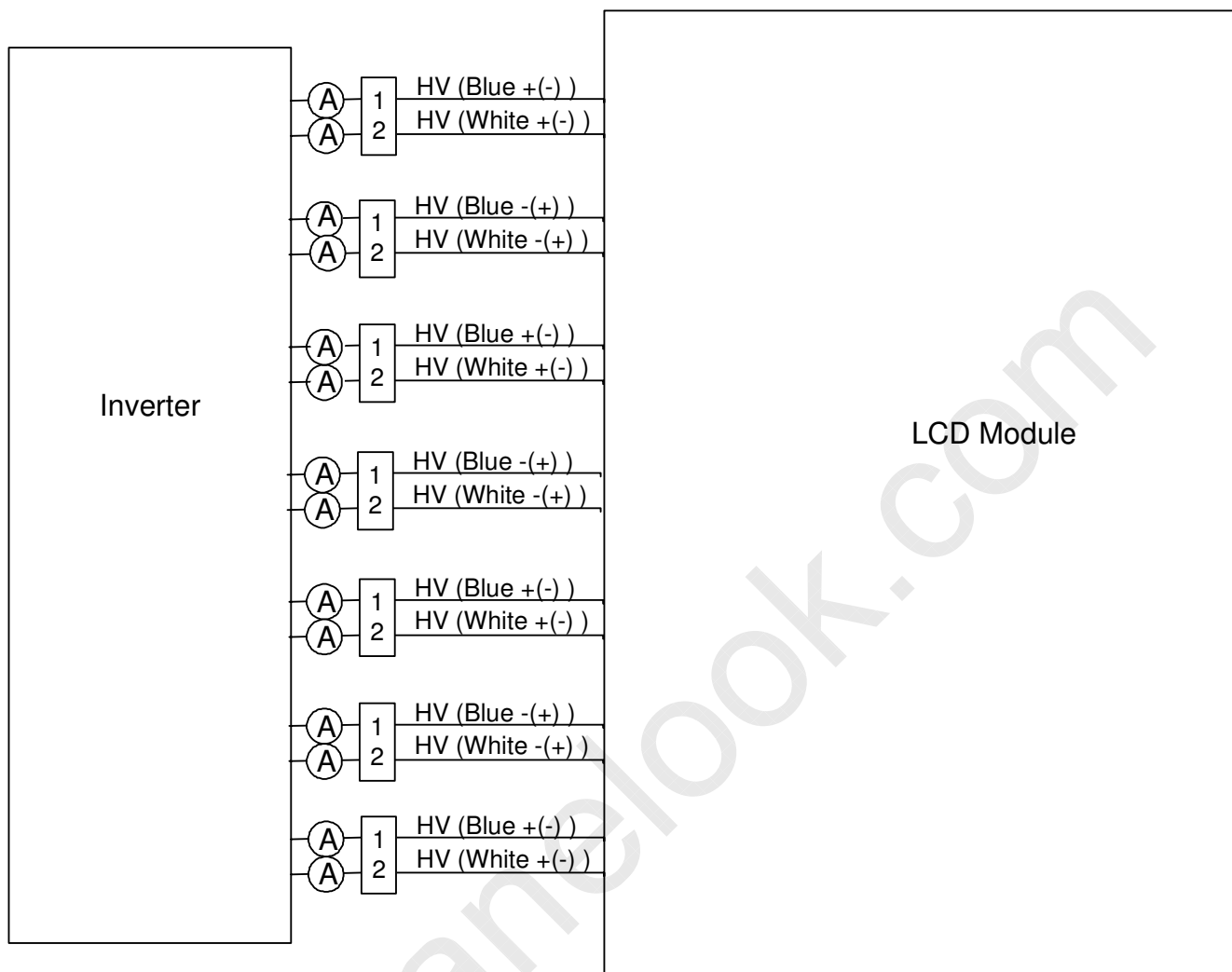
Note (6) The measurement condition of Max. value is based on 46" backlight unit under input voltage 24V, average lamp current 10.5 mA and lighting 30 minutes later.



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3.2.3 INVERTER INTERFACE CHARACTERISTICS

Parameter		Symbol	Test Condition	Value			Unit	Note
				Min.	Typ.	Max.		
On/Off Control Voltage	ON	V _{BLON}	—	2.0	—	5.0	V	
	OFF		—	0	—	0.8	V	
Internal PWM Control Voltage	MAX	V _{IPWM}	—	2.85	3.0	3.15	V	Maximum duty ratio
	MIN			—	0	—	V	Minimum duty ratio
External PWM Control Voltage	HI	V _{EPWM}	—	2.0	—	5.0	V	Duty on
	LO			0	—	0.8	V	Duty off
Status Signal	HI	Status	—	3.0	3.3	3.6	V	Normal
	LO			0	—	0.8	V	Abnormal
VBL Rising Time		Tr1	—	30	—	—	ms	10%-90%V _{BL}
VBL Falling Time		Tf1	—	30	—	—	ms	
Control Signal Rising Time		Tr	—	—	—	100	ms	
Control Signal Falling Time		Tf	—	—	—	100	ms	
PWM Signal Rising Time		T _{PWMR}	—	—	—	50	us	
PWM Signal Falling Time		T _{PWMF}	—	—	—	50	us	
Input impedance		R _{IN}	—	1	—	—	MΩ	
PWM Delay Time		T _{PWM}	—	100	—	—	ms	
BLON Delay Time		T _{on}	—	300	—	—	ms	
		T _{on1}	—	300	—	—	ms	
BLON Off Time		T _{off}	—	300	—	—	ms	

Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the internal/external PWM signal during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the following figure. For a certain reason, the inverter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

Turn ON sequence: VBL → PWM signal → BLON

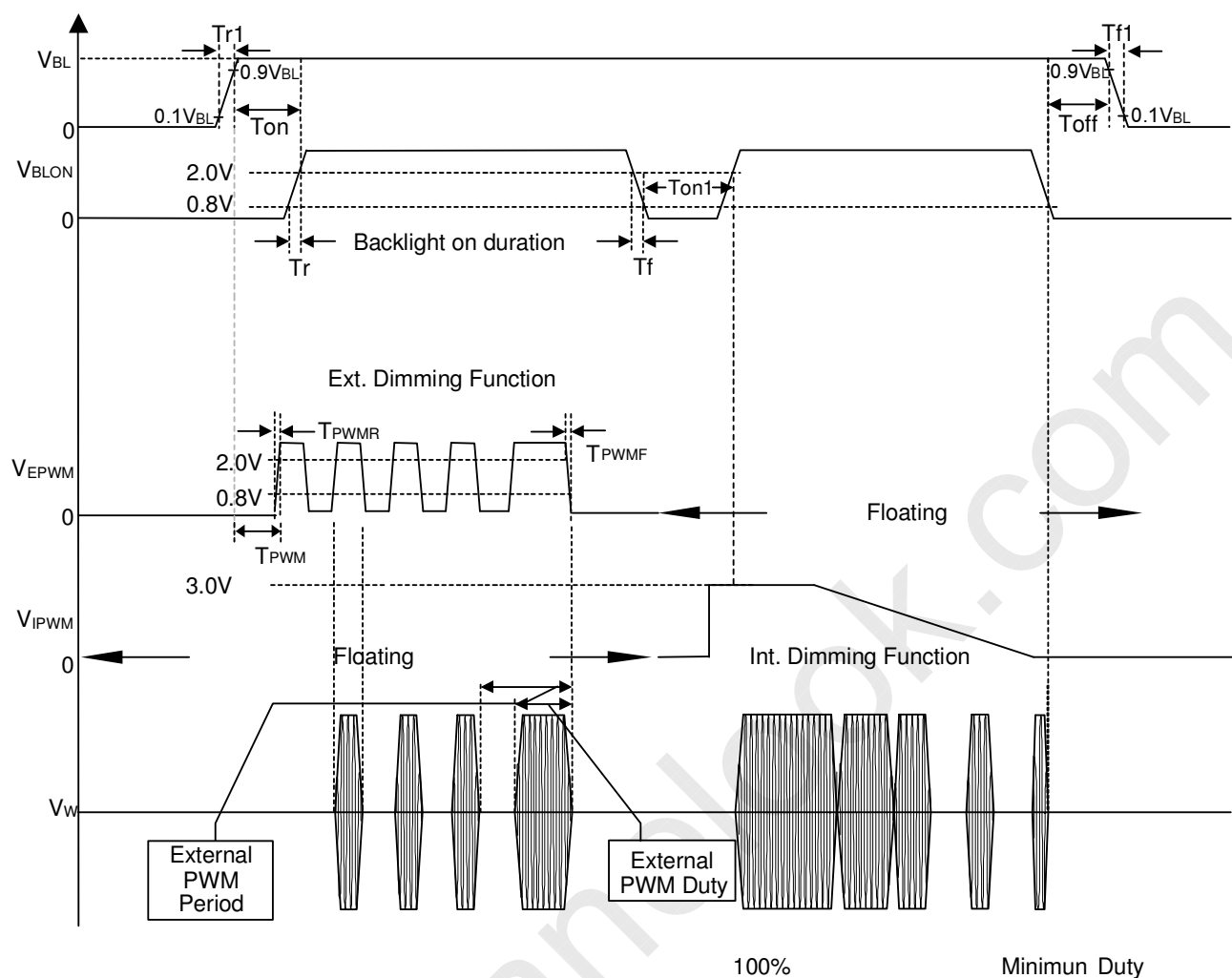
Turn OFF sequence: BLOFF → PWM signal → VBL



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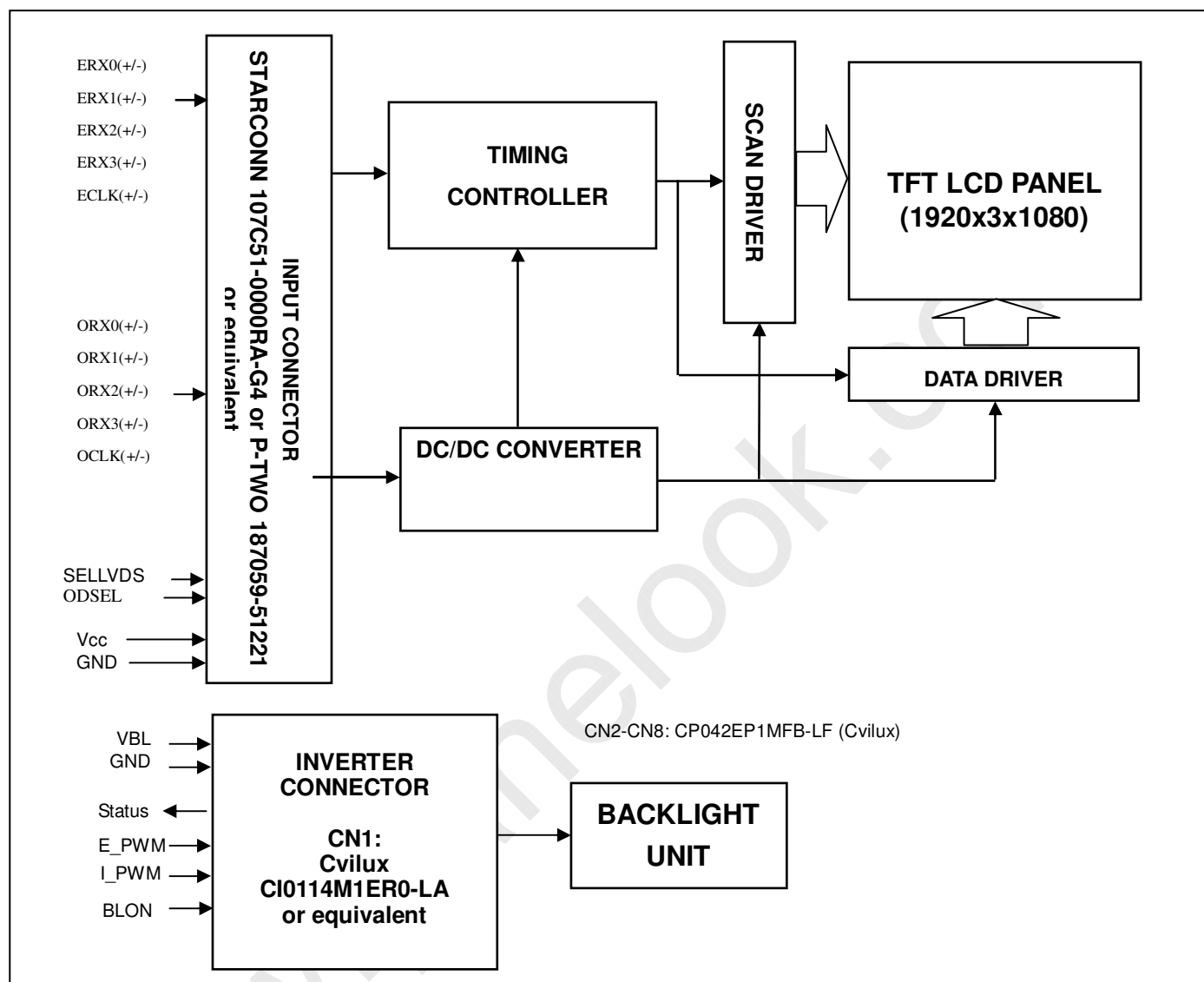
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Model No.: V460H1 - L09

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4. BLOCK DIAGRAM OF INTERFACE

4.1 TFT LCD MODULE





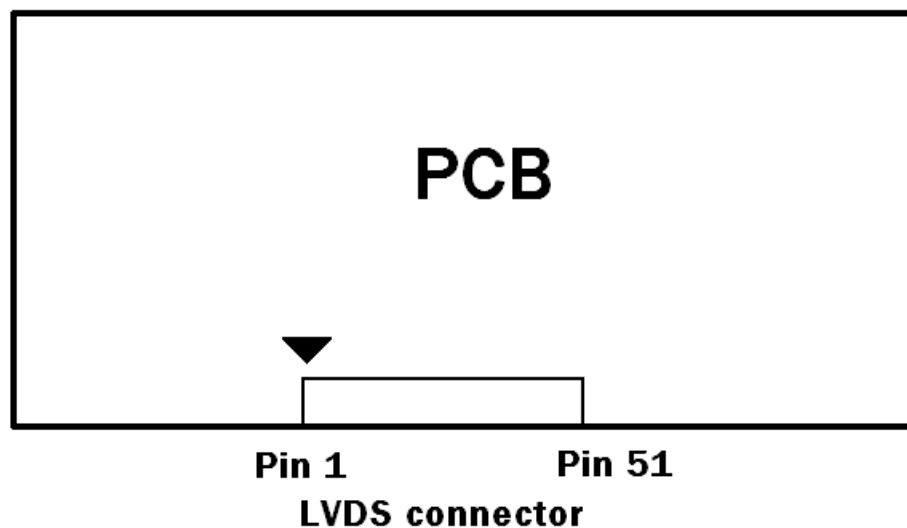
5 .INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD Module

Pin	Name	Description	Note
1	GND	Ground	
2	N.C.	No Connection	(2)
3	N.C.	No Connection	
4	N.C.	No Connection	
5	N.C.	No Connection	
6	N.C.	No Connection	
7	SELLVDS	LVDS data format Selection	(3)(5)
8	N.C.	No Connection	(2)
9	ODSEL	Overdrive Lookup Table Selection	(4)(6)
10	N.C.	No Connection	(2)
11	GND	Ground	
12	ERX0-	Even pixel Negative LVDS differential data input. Channel 0	(7)
13	ERX0+	Even pixel Positive LVDS differential data input. Channel 0	(7)
14	ERX1-	Even pixel Negative LVDS differential data input. Channel 1	(7)
15	ERX1+	Even pixel Positive LVDS differential data input. Channel 1	(7)
16	ERX2-	Even pixel Negative LVDS differential data input. Channel 2	(7)
17	ERX2+	Even pixel Positive LVDS differential data input. Channel 2	(7)
18	GND	Ground	
19	ECLK-	Even pixel Negative LVDS differential clock input.	(7)
20	ECLK+	Even pixel Positive LVDS differential clock input.	(7)
21	GND	Ground	
22	ERX3-	Even pixel Negative LVDS differential data input. Channel 3	(7)
23	ERX3+	Even pixel Positive LVDS differential data input. Channel 3	(7)
24	N.C.	No Connection	(2)
25	N.C.	No Connection	(2)
26	GND	Ground	
27	GND	Ground	
28	ORX0-	Odd pixel Negative LVDS differential data input. Channel 0	(7)
29	ORX0+	Odd pixel Positive LVDS differential data input. Channel 0	(7)
30	ORX1-	Odd pixel Negative LVDS differential data input. Channel 1	(7)
31	ORX1+	Odd pixel Positive LVDS differential data input. Channel 1	(7)
32	ORX2-	Odd pixel Negative LVDS differential data input. Channel 2	(7)
33	ORX2+	Odd pixel Positive LVDS differential data input. Channel 2	(7)
34	GND	Ground	
35	OCLK-	Odd pixel Negative LVDS differential clock input	(7)
36	OCLK+	Odd pixel Positive LVDS differential clock input	(7)
37	GND	Ground	
38	ORX3-	Odd pixel Negative LVDS differential data input. Channel 3	(7)
39	ORX3+	Odd pixel Positive LVDS differential data input. Channel 3	(7)
40	N.C.	No Connection	(2)
41	N.C.	No Connection	(2)
42	GND	Ground	
43	GND	Ground	
44	GND	Ground	
45	GND	Ground	
46	GND	Ground	
47	N.C.	No Connection	(2)
48	VCC	Power input (+12V)	
49	VCC	Power input (+12V)	
50	VCC	Power input (+12V)	

51	VCC	Power input (+12V)	
----	-----	--------------------	--

Note (1) LVDS connector pin order defined as follows



Note (2) Reserved for internal use. Please leave it open.

Note (3) Low = Open or connect to GND: VESA Format, High = Connect to +3.3V: JEIDA Format.

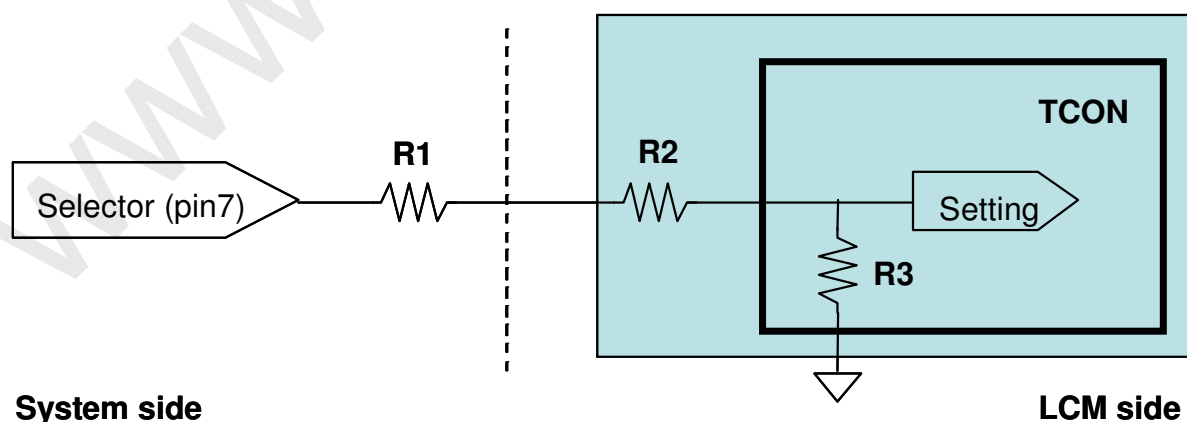
Note (4) Overdrive lookup table selection. The overdrive lookup table should be selected in accordance with the frame rate to optimize image quality.

Low = Open or connect to GND, High = Connect to +3.3V

ODSEL	Note
L or open	Lookup table was optimized for 60 Hz frame rate.
H	Lookup table was optimized for 50 Hz frame rate.

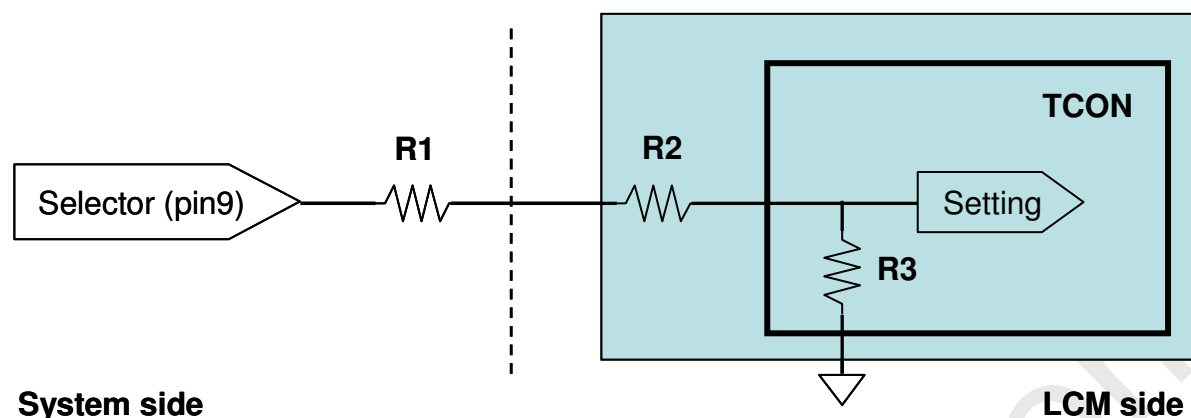
Note (5) LVDS signal pin connected to the LCM side has the following diagram.

R1 in the system side should be less than 1K Ohm. ($R1 < 1K \text{ Ohm}$)



Note (6) ODSEL signal pin connected to the LCM side has the following diagram.

R1 in the system side should be less than 1K Ohm. ($R1 < 1K \text{ Ohm}$)

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Notes (7) Two pixel data send into the module for every clock cycle. The first pixel of the frame is odd pixel and the second pixel is even pixel.

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Model No.: V460H1 - L09

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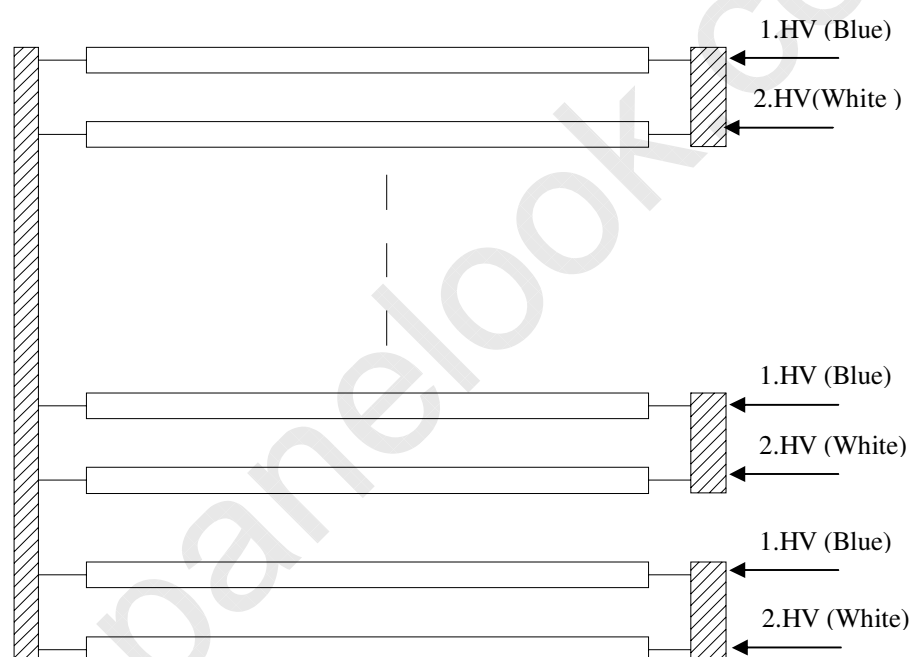
5.2 BACKLIGHT UNIT

The pin configuration for the housing and the leader wire is shown in the table below.

CN2-CN8: CP042EP1MFB-LF (Cvilux)

Pin	Name	Description	Wire Color
1	HV	High Voltage	Blue
2	HV	High Voltage	White

Note (1) The backlight interface housing for high voltage side is a model CP042EP1MFB-LF, manufactured by Cvilux. The mating header on inverter part number is CP042EP1MFB-LF (Cvilux)



5.3 INVERTER UNIT

CN1: CI0114M1ER0-LA (Cvilux) or equivalent

Pin No	Symbol	Feature
1	VBL	+24V
2		
3		
4		
5		
6	GND	GND
7		
8		
9		
10		
11	STATUS	Normal (3.3V) Abnormal(GND)
12	E_PWM	External PWM Control Signal
13	I_PWM	Internal PWM Control Signal
14	BLON	BL ON/OFF

Note (1) Pin 12: External PWM control (use pin 12): Pin 13 must open.

Note (2) Pin 13: Internal PWM control (use pin 13): Pin 12 must open.

Note (3) Pin 12 and Pin 13 can't open in the same period.

CN2~CN8: CP042EP1MFB-LF (Cvilux)

Pin No	Symbol	Description
1	CCFL HOT	CCFL high voltage
2	CCFL HOT	CCFL high voltage

ER0~ER7 : Even pixel R data

EG0~EG7 : Even pixel G data

EB0~EB7 : Even pixel B data

OR0~OR7 : Odd pixel R data

OG0~OG7 : Odd pixel G data

OB0~OB7 : Odd pixel B data

DE : Data enable signal

DCLK : Data clock signal

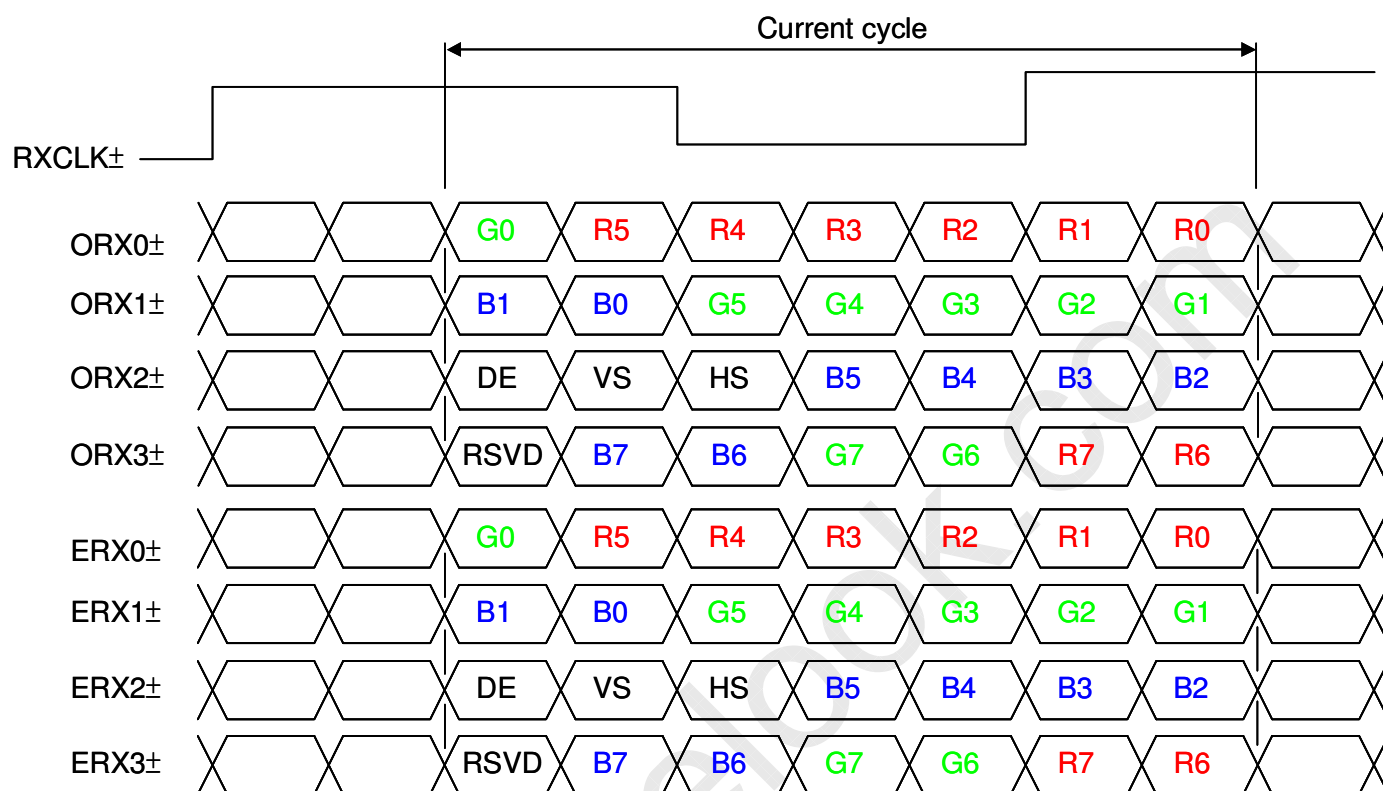
Notes (1) The system must have the transmitter to drive the module.

Notes (2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

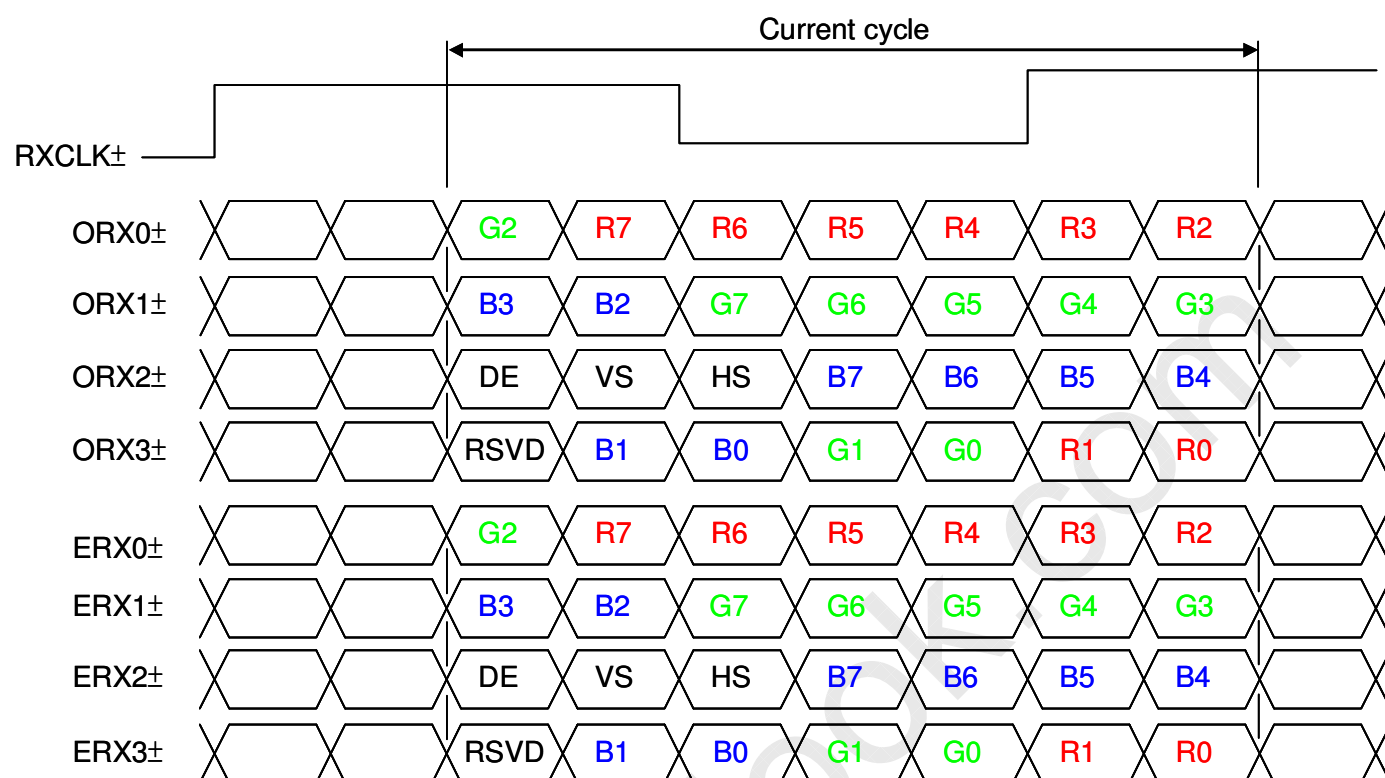
Notes (3) Two pixel data send into the module for every clock cycle. The first pixel of the frame is odd pixel and the second pixel is even pixel.

5.5 LVDS INTERFACE

VESA LVDS format : (SELLVDS pin=L or OPEN)



JEDIA LVDS format : (SELLVDS pin=H)



R0~R7: Pixel R Data (7; MSB, 0; LSB)

G0~G7: Pixel G Data (7; MSB, 0; LSB)

B0~B7: Pixel B Data (7; MSB, 0; LSB)

DE : Data enable signal

DCLK : Data clock signal

Notes: (1) RSVD (reserved) pins on the transmitter shall be "H" or "L".

5.6 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red (253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

(Ta = 25 ± 2 °C)

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	Frequency	F_{clkin} (=1/Tc)	60	74.25	80	MHz	
	Input cycle to cycle jitter	T_{rcj}	-200	—	200	ps	(3)
	Spread spectrum modulation range	F_{clkin_mod}	$F_{clkin}-2\%$	—	$F_{clkin}+2\%$	MHz	(4)
	Spread spectrum modulation frequency	F_{SSM}			200	KHz	
LVDS Receiver Data	Setup Time	T_{lvsu}	600	—	—	ps	(5)
	Hold Time	T_{lvhd}	600	—	—	ps	
Vertical Active Display Term	Frame Rate	F_{r5}	47	50	53	Hz	(6)
		F_{r6}	57	60	63	Hz	
	Total	T_v	1115	1125	1135	Th	$T_v=T_{vd}+T_{vb}$
	Display	T_{vd}	1080	1080	1080	Th	—
	Blank	T_{vb}	35	45	55	Th	—
Horizontal Active Display Term	Total	T_h	1050	1100	1150	Tc	$T_h=T_{hd}+T_{hb}$
	Display	T_{hd}	960	960	960	Tc	—
	Blank	T_{hb}	90	140	190	Tc	—

Note (1) Please make sure the range of pixel clock has follow the below equation :

$$F_{clkin(max)} \geq F_{r6} \times T_v \times T_h$$

$$F_{r5} \times T_v \times T_h \geq F_{clkin(min)}$$

Note (2) This module is operated in DE only mode and please follow the input signal timing diagram below :

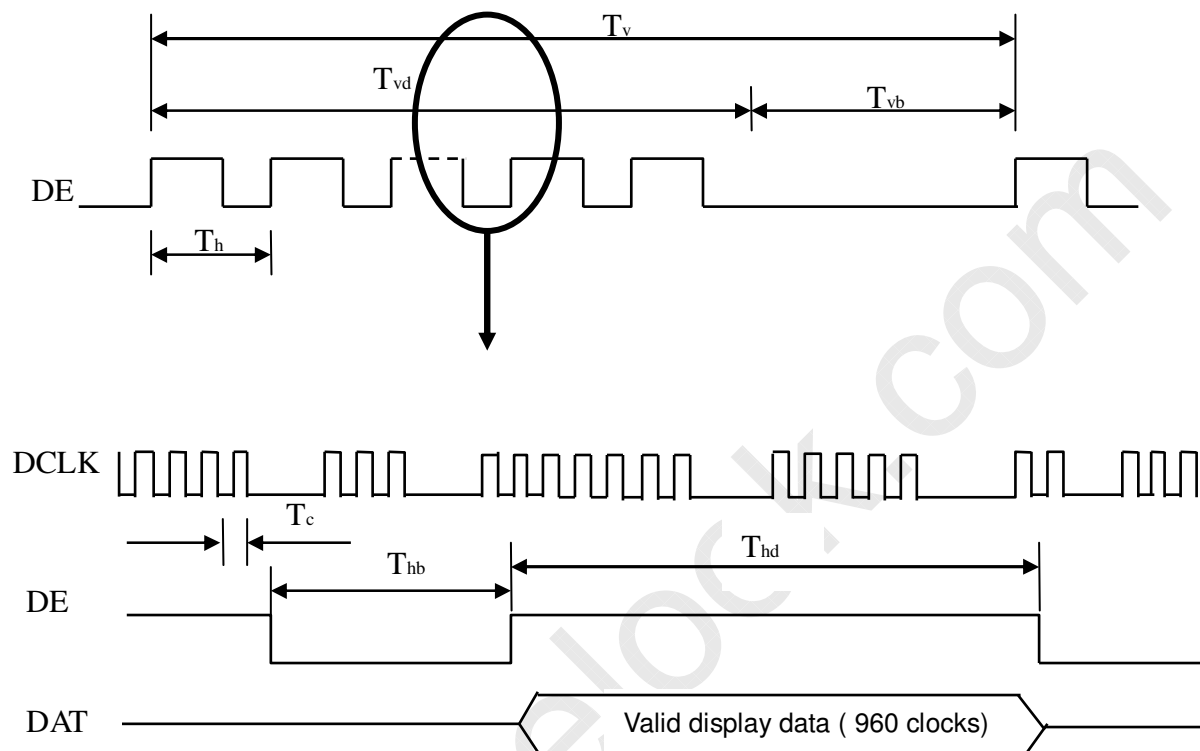


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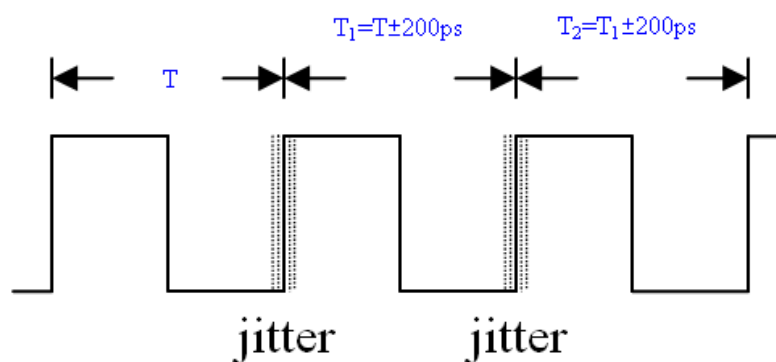
Issued Date: Nov. 30, 2009
Model No.: V460H1 - L09

Tentative

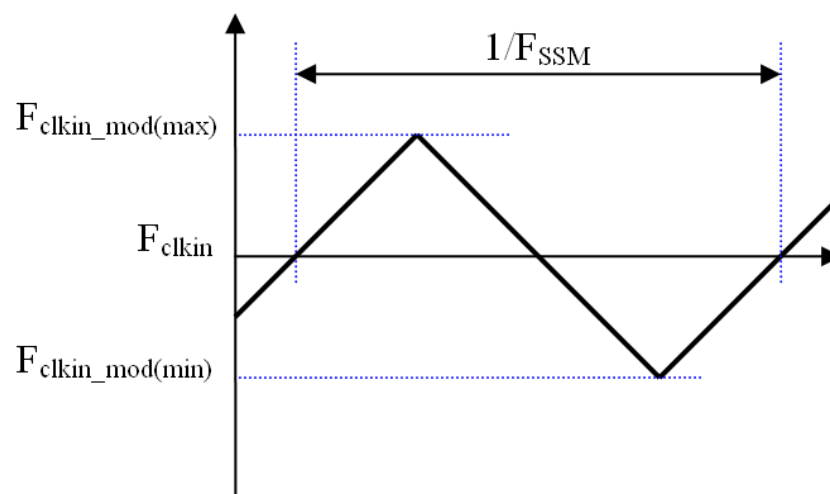
INPUT SIGNAL TIMING DIAGRAM



Note (3) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T_1 - T_1|$

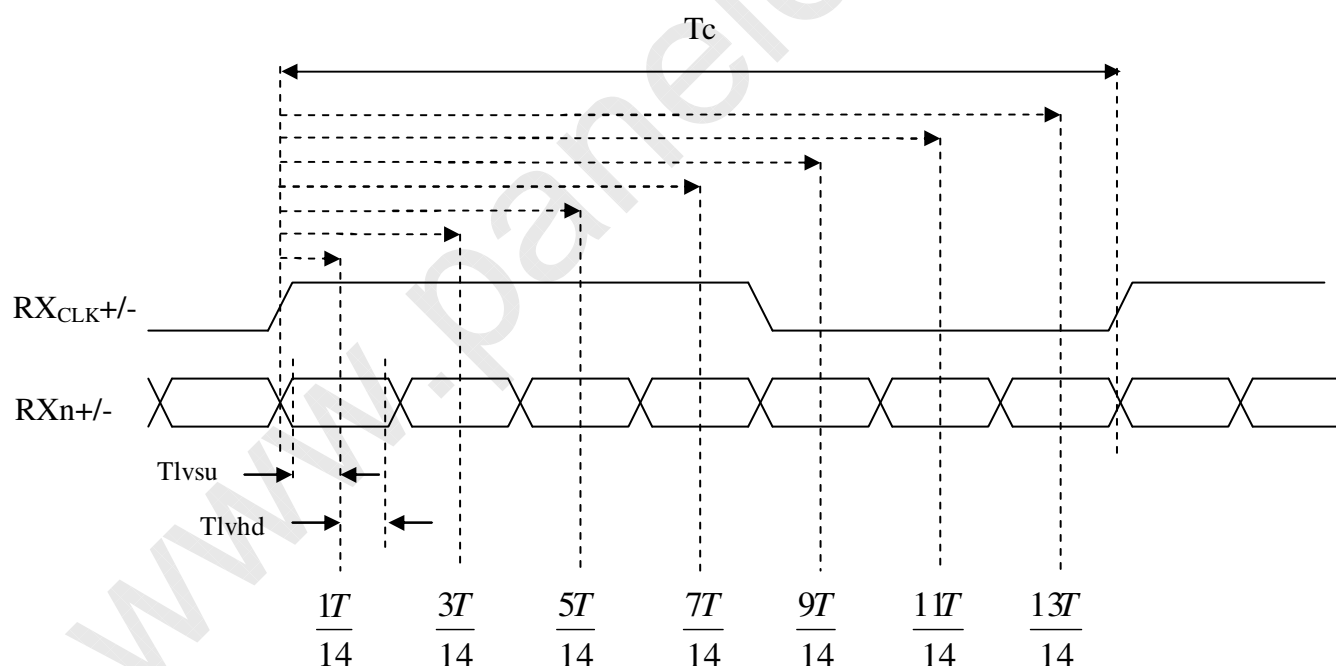


Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (5) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.

LVDS RECEIVER INTERFACE TIMING DIAGRAM

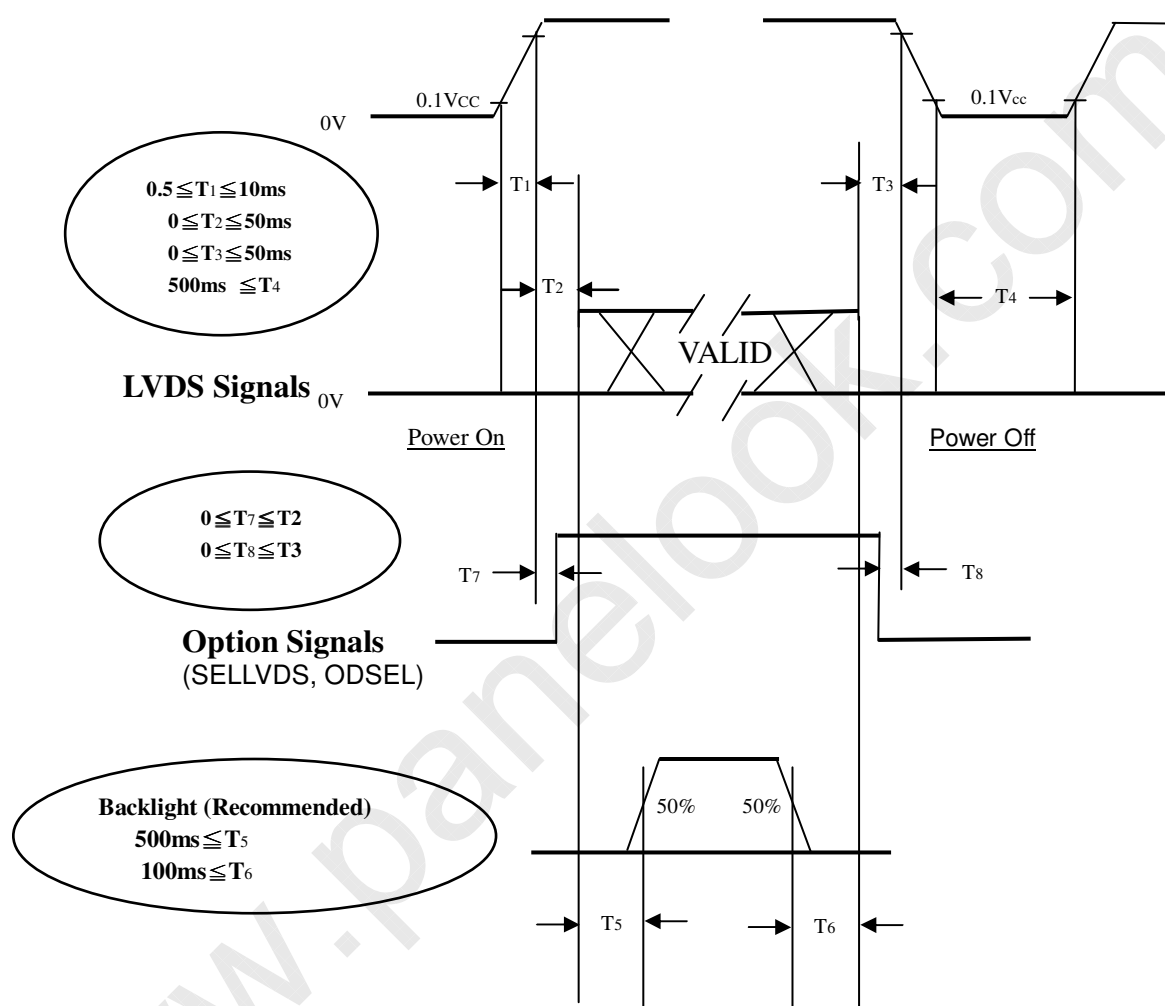


Note (6) : (ODSEL) = H/L or open for 50/60Hz frame rate. Please refer to 5.1 for detail information

6.2 POWER ON/OFF SEQUENCE

($T_a = 25 \pm 2^\circ\text{C}$)

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should follow the diagram below.



Power ON/OFF Sequence

Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance. If $T_2 < 0$, that maybe cause electrical overstress failure.

Note (4) T_4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	12V	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Lamp Current	I _L	12.0±0.5	mA
Oscillating Frequency (Inverter)	F _W	40±3	KHz
Vertical Frame Rate	Fr	60	Hz

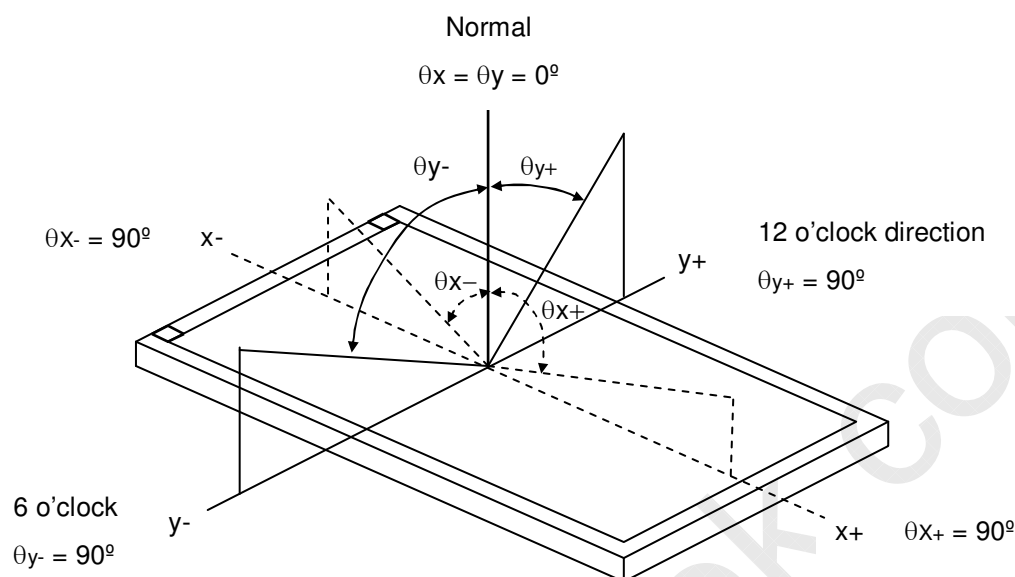
7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_Y=0^\circ$ Viewing angle at normal direction	4500	6000	-	-	Note (2)
Response Time		Gray to gray		-	6.5	12	ms	Note (3)
Center Luminance of White		L _C		360	450	-	cd/m ²	Note (4)
White Variation		δW		-	-	1.3	-	Note (7)
Cross Talk		CT		-	-	4	%	Note (5)
Color Chromaticity	Red	R _x		Typ.-0.03	(0.633)	Typ.+0.03	-	Note (6)
		R _y			(0.324)		-	
	Green	G _x			(0.284)		-	
		G _y			(0.599)		-	
	Blue	B _x			(0.147)		-	
		B _y	(0.048)		-			
	White	W _x	0.280		-			
		W _y	0.290		-			
	Color Gamut				70		72	
Viewing Angle	Horizontal	θ _{x+}	CR≥20	80	88	-	Deg.	Note (1)
		θ _{x-}		80	88	-		
	Vertical	θ _{y+}		80	88	-		
		θ _{y-}		80	88	-		

Note (1) Definition of Viewing Angle (θ_x, θ_y):

Viewing angles are measured by Autronic Conoscope Cono-80



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

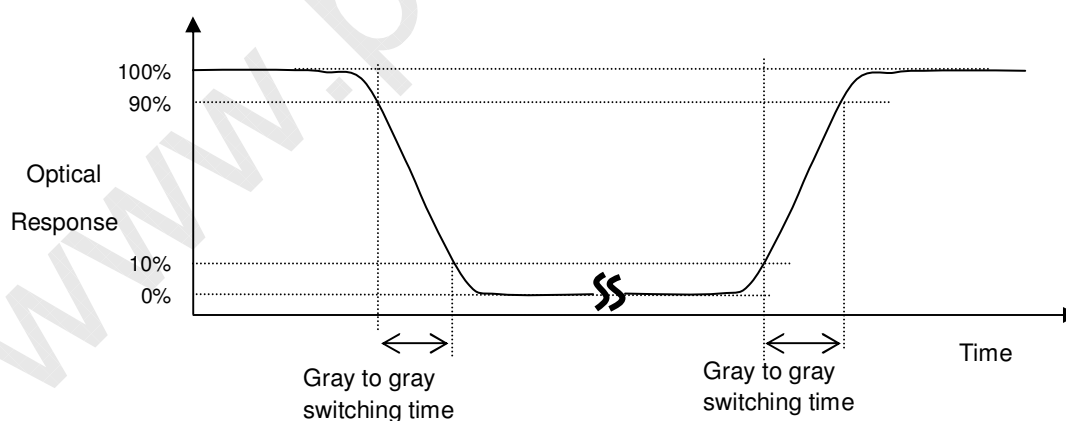
$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (7)

Note (3) Definition of Gray to Gray Switching Time :



The driving signal means the signal of gray level 0, 63, 127, 191, and 255.

Gray to gray average time means the average switching time of gray level 0, 63, 127, 191, 255 to each other.

Note (4) Definition of Luminance of White (L_C):

Measure the luminance of gray level 255 at center point.

$L_C = L(5)$, where $L(x)$ is corresponding to the luminance of the point X at the figure in Note (7).

Note (5) Definition of Cross Talk (CT):

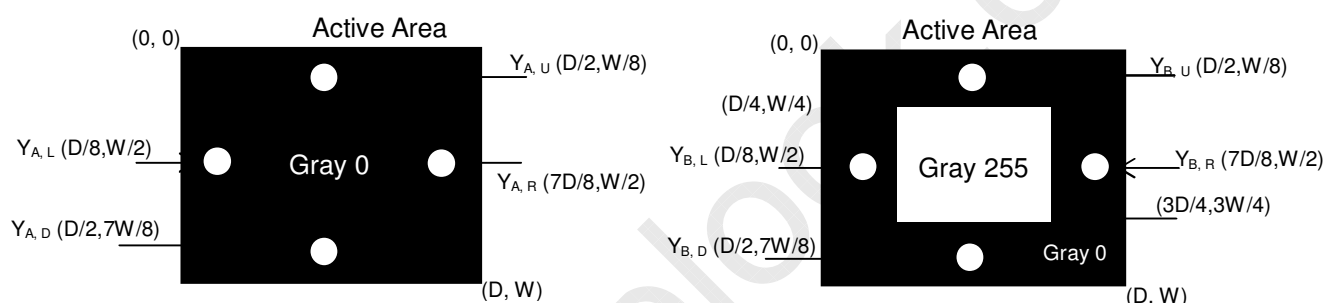
$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Where:

(a)

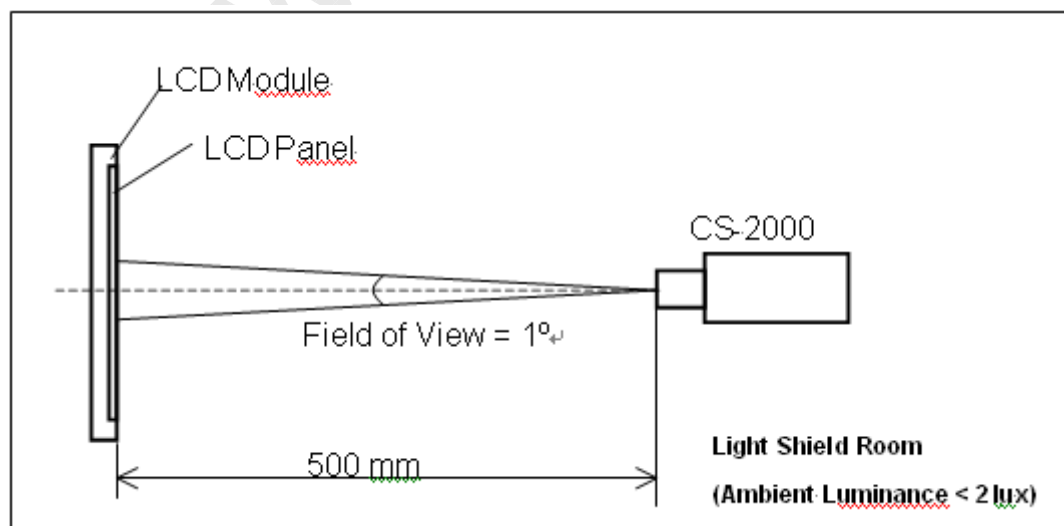
Y_A = Luminance of measured location without gray level 255 pattern (cd/m^2)

Y_B = Luminance of measured location with gray level 255 pattern (cd/m^2)



Note (6) Measurement Setup:

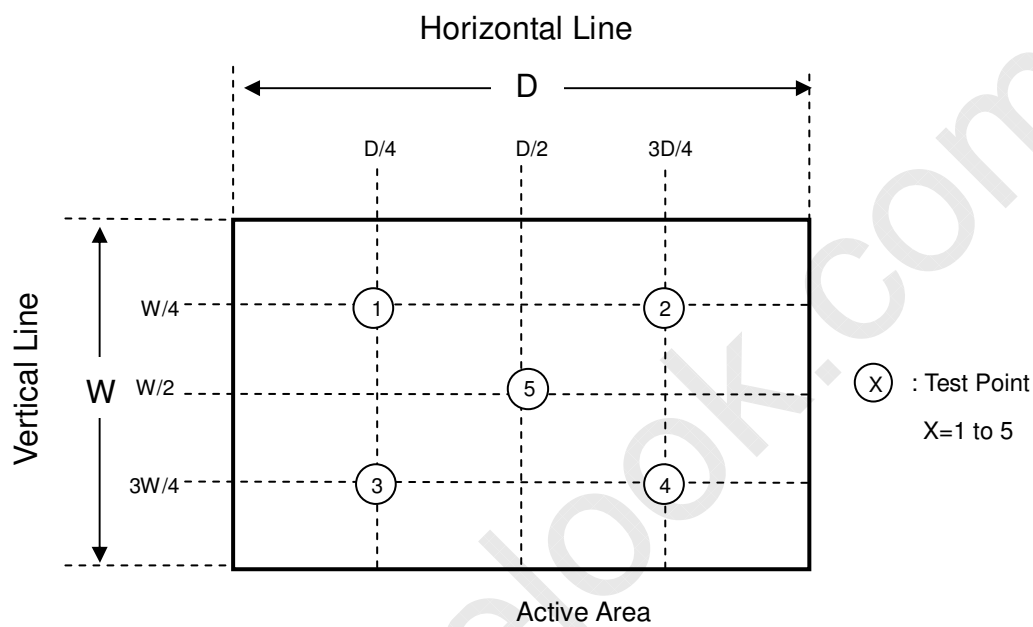
The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 1 hour in a windless room.



Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

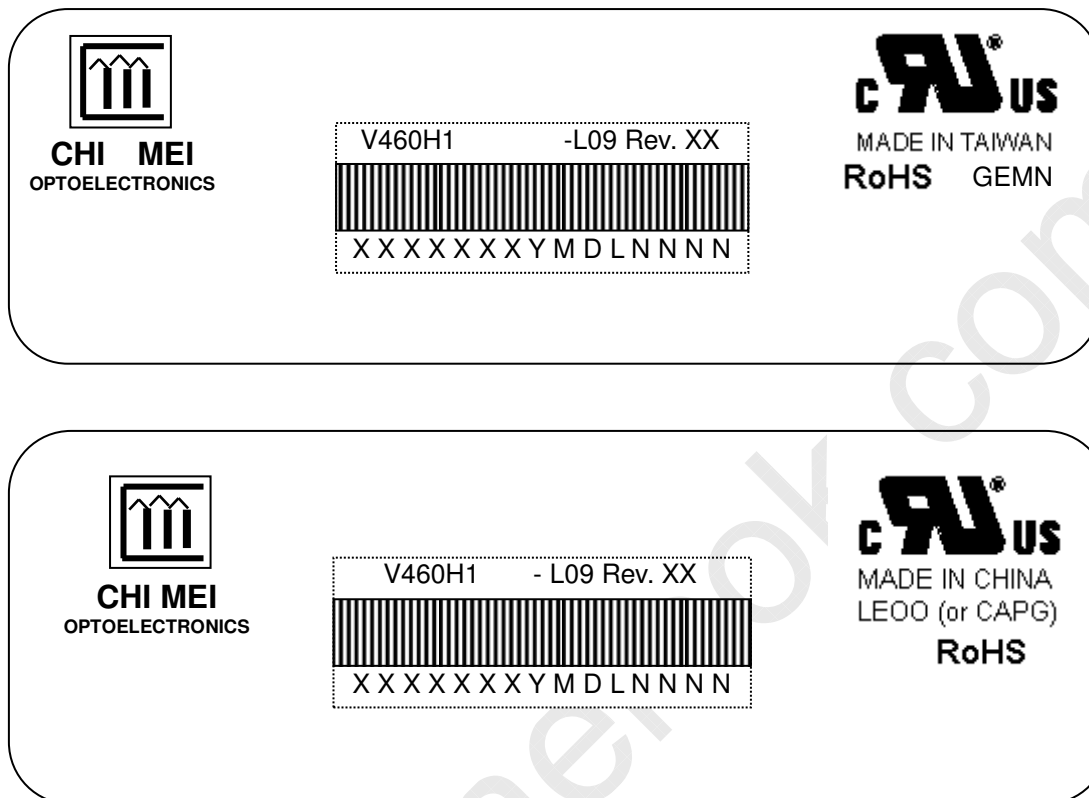
$$\delta W = \text{Maximum [L (1), L (2), L (3), L (4), L (5)]} / \text{Minimum [L (1), L (2), L (3), L (4), L (5)]}$$



8. DEFINITION OF LABELS

8.1 CMO MODULE LABEL

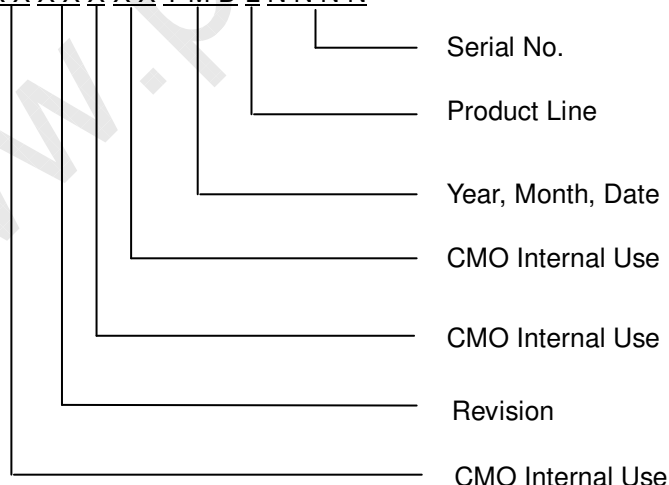
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: V460H-L09

(b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.

(c) Serial ID: XXXXXXXYMDLNNNN



(d) Production Location:XXXX, for example:TAIWAN or CHINA .

Serial ID includes the information as below:

(a) Manufactured Date: Year: 0~9, for 2000~2009

Month: 1~9, A~C, for Jan. ~ Dec.

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Model No.: V460H1 - L09**Tentative**Day: 1~9, A~Y, for 1st to 31st, exclude I, O, and U.

(b) Revision Code: Cover all the change

(c) Serial No.: Manufacturing sequence of product

Product Line: 1 -> Line1, 2 -> Line 2, ...etc.

9. PACKAGING

9.1 PACKING SPECIFICATIONS

- (1) 3 LCD TV modules / 1 Box
- (2) Box dimensions: 1144(L)x 266(W)x 725(H)mm
- (3) Weight: approximately 45Kg (3 modules per box)

9.2 PACKING METHOD

Figures 9-1 and 9-2 are the packing method

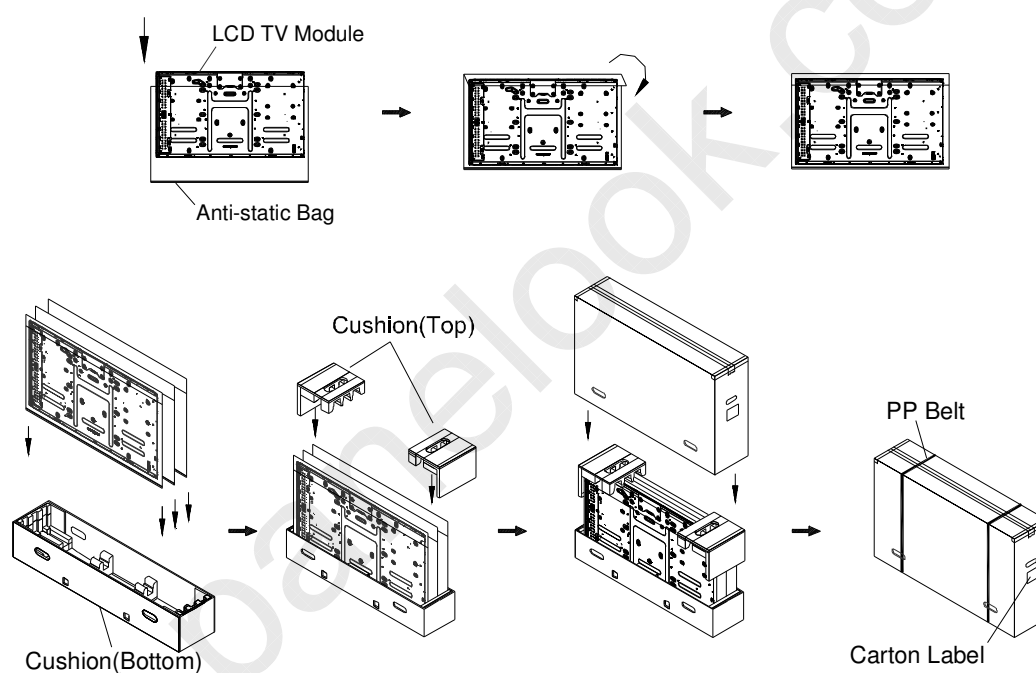
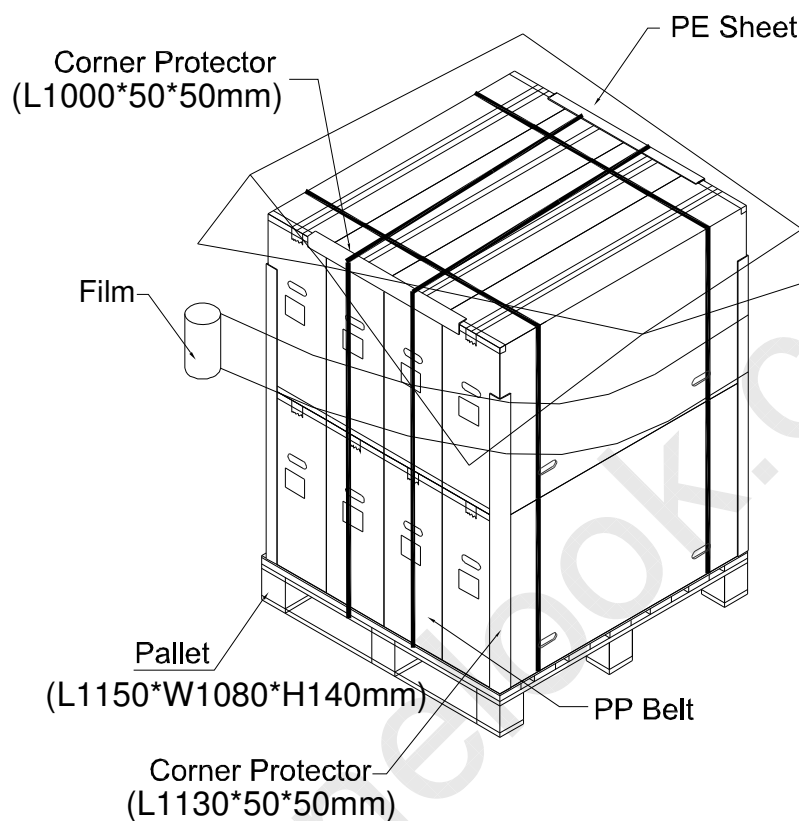


Figure.9-1 packing method

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Model No.: V460H1 - L09**Tentative**

Air Transportation & Sea / Land Transportation (40ft Container)



Sea / Land Transportation (40ft HQ Container)

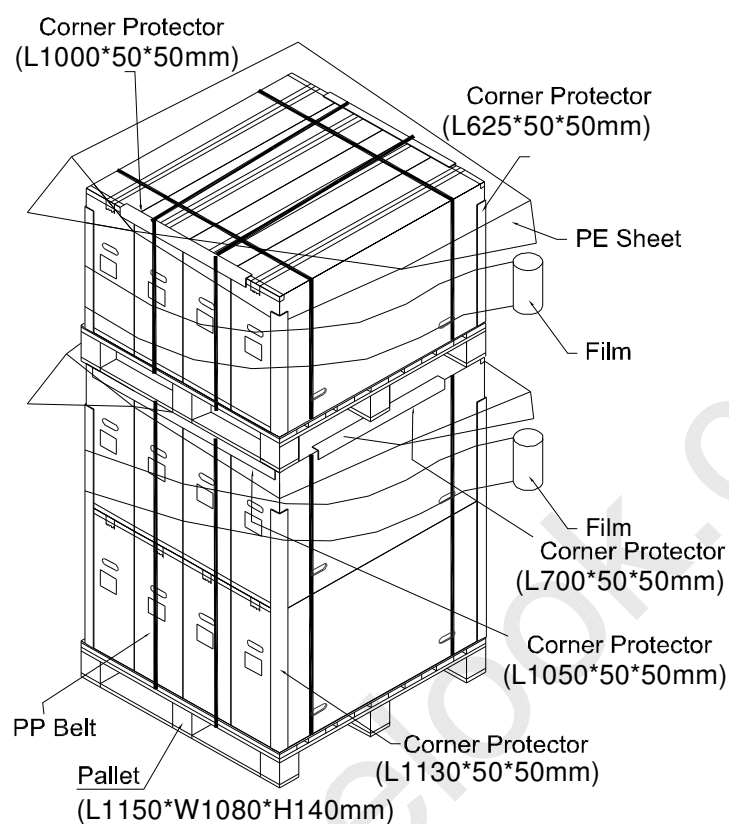


Figure.9-2 packing method

10. PRECAUTIONS

10.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD modules in the specified storage conditions.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

10.2 SAFETY PRECAUTIONS

- (1) The startup voltage of a backlight is over 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.

10.3 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

Regulatory	Item	Standard
Information Technology equipment	UL	UL 60950-1: 2003
	cUL	CAN/CSA C22.2 No.60950-1-03
	CB	IEC 60950-1:2001
Audio/Video Apparatus	UL	UL 60065: 2003
	cUL	CAN/CSA C22.2 No.60065-03
	CB	IEC 60065:2001

If the module displays the same pattern for a long period of time, the phenomenon of image sticking may be occurred.

11. MECHANICAL CHARACTERISTIC

